# HOPE BAY PROJECT
# GROUNDWATER MANAGEMENT PLAN

AGNICO EAGLE
HOPE BAY

HOPE BAY, NUNAVUT

MARCH 2022

Hope Bay Project Groundwater Management Plan

Plain Language Overview:

This Groundwater Management Plan describes how Agnico will manage and work to minimize water that flows into the mine to protect workers, the environment, and ensure the mine can keep operating.

Hope Bay, Nunavut

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# Revisions

| Revision # | Date | Section | Changes Summary | Author | Approver |
|---|---|---|---|---|---|
| 00 | June 2016 | Entire Document | Initial Document | SRK | TMAC |
| 01 | August 2016 | Section 2.2 | Updated clarification of possible increased groundwater inflow to the mine | | |
| | | Section 6 | Updated remedial stage actions for mine inflow management | | |
| | | Section 5.2 | Updated water quality testing requirements | | |
| | | Section 2.3.1, Table 2 and Section 8 | Addition of management response for mine inflows exceeding 3,000 $m^3$/day | | |
| 02 | November 2017 | Entire Document | Transfer to new template | SRK | TMAC |
| | | Section 1 | Updated this section to consider all mines, i.e., Doris, Madrid, and Boston mines. Added objective of avoiding taliks or subpermafrost where mining is planned to remain encapsulated in permafrost. Updated Table 1. Compiled in Table 3 the roles and responsibilities for this plan. | | |
| | | Module A | Corrected a typo error with the groundwater pumping rate expressed in $m^3$/quarter, in the SPT3 row. | | |
| | | Module B | Developed a specific MIMP for the Madrid mines | | |
| | | Module C | Developed a specific MIMP for the Boston mine | | |
| 03 | March 2020 | Section 2.1 | Updated to include aspects of mine water treatment | TMAC | TMAC |
| 04 | March 2022 | Throughout | Updated references to AEM, updated to consider current mining practices | AEM | AEM |

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# Glossary

| Term | Definition |
|---|---|
| ARD | Acid rock drainage |
| AEM | Agnico Eagle Mines |
| AEMP | Aquatic effects monitoring program |
| EC | Electrical conductivity |
| GWMP | Groundwater management plan |
| L/s | Litres per second |
| $m^3$/day | Cubic meter of water per day (equivalent to 1,000 litres per day) |
| MIMP | Mine inflow management program |
| MMER | Metal mining effluent regulations |
| NIRB | Nunavut impact review board |
| NWB | Nunavut water board |
| QA/QC | Quality assurance / quality control |
| RBDS | Roberts Bay Discharge System |
| SOP | Standard operating procedure |
| SPT | Specific performance thresholds |
| TIA | Tailings impoundment area |
| TDS | Total dissolved solids |
| TMAC | TMAC Resources Inc. |
| TSS | Total suspended solids |
| WAD | Weak acid dissociable |
| WMP | Water management plan |
| WTP | Water Treatment Plant |

# 1 Introduction

This *Hope Bay Project Groundwater Management Plan* (the Plan) has been prepared by Agnico Eagle Mines (Agnico) in accordance with various water licences held by TMAC associated with developments throughout the Hope Bay region.

The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices for minimizing potential environmental impacts and potential environmental liabilities with respect to groundwater management are followed, and that the conditions of water licences are met.

This Plan is structured in a manner such that one document pertaining to groundwater management is approved and implemented across all Agnico Hope Bay project sites, while still addressing site- and licence-specific needs: the main document outlines Agnico's approach to groundwater management as it pertains to all Agnico Hope Bay developments; subsequent modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, only the specific modules pertaining to that licence and site will need to be revised. This is intended for consistency and efficiency across operations and for compliance management.

## 1.1 Objectives

The Hope Bay Project is being developed in permafrost, talik (i.e., unfrozen ground formed by lakes) and subpermafrost (i.e., the non-frozen ground below the permafrost). No groundwater interaction will be encountered in permafrost zones but mining in taliks or subpermafrost will result in groundwater inflows from defined geological features or open drill holes. The mine inflows will be made up of fresh water from lake infiltrations and hypersaline water from the surrounding rock, with a water quality dominated by high salinity, specifically chloride. Groundwater will be collected in underground sumps and pumped to surface, from where it will be discharged to a marine outfall diffuser in Roberts Bay, either directly, or via the Tailings Impoundment Area (TIA). The estimated mine inflows (quantity and quality) are not expected to cause safety concerns or environmental impacts. To ensure this, Agnico will actively manage and mitigate inflows to protect workers, the environment, and ensure the mine can keep operating. The objectives of the GWMP are to:

- Avoid taliks or subpermafrost in areas where mining is planned to remain encapsulated in permafrost;
- Minimize influence of mining in taliks on lake water levels; and
- Integrate the mine inflow volumes and chemistry, and resulting loading into the Water Management Plan (WMP).

This is accomplished by:

- Describing issues related to groundwater flow into the mines; and
- Outlining management responses, mitigations and adaptive management measures taken to protect workers and the environment, and to minimise operational impacts.

## 1.2 Relevant Legislation and Guidance

Table 1.1 provides a summary of federal and territorial regulations, and associated guidelines, governing the Hope Bay Groundwater Management Plan.

Table 1.1: List of federal and territorial regulations governing the Hope Bay Project Groundwater Management Plan

| Regulation | Year | Governing Body | Relevance |
|---|---|---|---|
| Nunavut Mine Health and Safety Act (S.N.W.T, 1994, c.25) | 1994 | Government of Nunavut | Regulate the operations of underground mines, including the management of incoming water. |
| Mine Health Safety Regulations (R-125-95) | 1995 | Department of Justice of the Northwest Territories Government | |
| Nunavut Waters Regulations | 2013 | Nunavut Water Board (NWB) | License for mining and milling undertaking to use water and deposit of waste in relation to the construction, operation, closure and reclamation. |
| Environmental Protection Act | 2011 | Government of Nunavut (GN), Department of Environment (DOE), Environmental Protection division | Legislation to authorize discharge of water. |
| Environmental Rights Act | 2011 | GN, DOE, Environmental Protection division | Grants all residents the ability to launch an investigation. |
| Metal and Diamond Mining Effluent Regulations (SOR/2002-222) | 2018 | Federal Department of Fisheries and Oceans & Environment Canada | Outlines requirements for mine-related discharges. |
| **Guideline** | **Year** | **Governing Body** | **Relevance** |
| Canadian Environmental Quality Guidelines | 1999 | Canadian Council of Ministers of the Environment (CCME) | Provides guidance on water quality for the protection of aquatic life; both freshwater and marine. |

## 1.3 Related Documents

Table 1.2 provides a summary of documents related to the Hope Bay Groundwater Management Plan.

Table 1.2. List of documents related to the Hope Bay Project Groundwater Management Plan

| Document Title | Year | Relevance |
|---|---|---|
| Hydrogeological Modeling of the Proposed Doris North Project | June 2015 | Documents the hydrogeological data and results of modelling designed to estimate inflows into the Doris underground mine during operations. |
| Doris North Project – Water and Load Balance | June 2015 | Evaluation and predictions of water quantity and quality at the Doris North project, including alternative discharge scenarios for groundwater and TIA effluent. |
| Response to NRCan IR-3 & AANDC IR#13: Estimation of the Time Required for the Underground Mine to Fill | Dec. 2015 | Provides an estimate of the time for reflooding the Doris underground mine once dewatering stops. |
| Appendix V3-4B issued for the FEIS of the Phase 2 Hope Bay Project. | Nov. 2017 | Documents the hydrogeological data and results of modelling designed to estimate inflows into the Madrid and Boston underground mines during operations. |
| Hope Bay Project – Water and Load Balance | Nov. 2017 | Evaluation and predictions of water quantity and quality at the Hope Bay project, including mining at Doris, Madrid, and Boston, as well as alternative discharge scenarios for groundwater and TIA effluent. |
| Hope Bay Project Doris and Madrid Water Management Plan | Mar. 2020 | Describes the water management procedures including discharge from the TIA and associated water quality criteria. |
| Aquatic Effects Monitoring Plan | Oct. 2018 | Describes the monitoring of the fisheries habitat. |
| Quality Assurance and Quality Control Plan | Mar. 2020 | Sampling practices document that is reviewed and approved by the NWB. |

## 1.4 Plan Management

This Plan is reviewed annually and updated as needed. Revisions can be triggered by activities such as changes in the mine plan, operational performance, personnel or organizational structure, mine ownership, regulatory or social considerations, and life cycle or design philosophy. Personnel responsible for implementing and updating the Plan are identified in Table 1.3.

Table 1.3. Roles and Responsibilities

| Role | Responsibility |
|---|---|
| Mine General Manager | • Overall responsibility for and implementation of this management plan;<br>• Provide the on-site resources to operate, manage, and maintain the groundwater management infrastructure, such as sumps, pumps, ponds and holding tanks;<br>• Provide input on modifications to design and operational procedures to improve operational performance. |
| Mine Superintendent | • Conduct regular inspections of the groundwater management facilities such as sumps and audits of the maintenance records;<br>• Responsible for tracking water movements from all underground sumps to the main underground sump<br>• Responsible for contacting Dewatering Supervisor regarding the final destination of groundwater to surface (ie WTP, TIA) to ensure compliance with all licence requirements<br>• ;<br>• Report irregularities identified during visual inspections to Engineering as it relates to inflows and to the Maintenance Department as it relates to maintenance. |
| Mine Engineering Superintendent | • Maintain records of underground inflows and their locations<br>• Track discrete underground inflows, their locations, and flow rates;<br>• Plan and design underground infrastructure relating to collection and movement of groundwater.<br>• Coordinate with the Maintenance Manager and Process Manager responsible for water movements between the various water management facilities to ensure compliance with all licence requirements;<br>• Audit of groundwater management tracking records and all associated required reporting.<br>• Understand water inflows resulting from mining activities through hydrogeological investigations<br>• Mitigate impacts from water inflows resulting from mining activities such as implementation of grouting programs, monitoring diamond drill hole interceptions. |
| Environmental Superintendent | • Review and update this management plan as required<br>• Collect water quality samples from sumps, backfilled stopes and WTP during periods of discharge;<br>• Monitor water quality in the sumps (i.e. calcium chloride concentrations);<br>• Maintain records of water quality sampling results. |
| Maintenance Superintendent | • Ensures dewatering supervisor provides direction to the mine regarding the destination of the groundwater at surface (ie WTP, TIA etc) to ensure compliance with all licence requirements<br>• Conduct regular inspection of the piping and pumps associated with the water movement underground |

# 2 Groundwater Management Issues

## 2.1 Mine Inflow Rates

The mine inflow rates may exceed the predicted inflows.

### 2.1.1 Management Action

Mine inflow thresholds are set for each mine, beyond which adaptive management needs to occur to mitigate increasing flow volume. Rates are reassessed as part of the annual review process of this Plan as understanding of the system increases.

Risk assessments are used to guide development plans, and control measures are put in place as outlined in Section 3. Management actions (i.e., control measures) are implemented based on a Mine Inflow Management Program (MIMP), as outlined in Section 4.

## 2.2 Mine Inflow Chemistry

The chemistry of discharged mine water may diverge from the predicted water quality.

### 2.2.1 Management Action

Operations induced water quality changes are managed to the extent practical. The use of calcium chloride is minimized to the extent possible in underground sumps and mine water is internally recycled for drilling purposes to reduce the amount of additional calcium chloride introduced to the mine.

Blasting practices are continuously reviewed to evaluate opportunities to reduce nitrates from blast residues in the mine water.

A series of long and shallow sumps (horizontal flow settlers) are utilized to aid in settling of coarse suspended solids. The system has been designed to act as primary treatment for coarse suspended solids prior to water being pumped to surface for secondary and tertiary treatment at the Water Treatment Plant.

Mine inflow quality is monitored in accordance with Section 5 of this Plan. If mine water discharge exceeds MDMER water quality criteria, discharge to Roberts Bay occurs via the TIA and/or with treatment.

Saline mine water may only be discharged together with tailings from, or within, 300 m of the South Dam provided the freezing point depression is less than 0.5$^{o}$C. If the freezing point depression exceeds 0.5$^{o}$C, saline mine water may be discharged with tailings at other designated tailings discharge points or directly into the Reclaim Pond.

## 2.3 Mine Discharge

The discharge rate from the mine may exceed the maximum acceptable inflow for a given period.

### 2.3.1 Management Action

The pumping designs comprise a primary set of pump(s) that can accommodate the design capacity, plus standby pump(s). Standby pump(s) are required to ensure that the full design capacity is available when pumps require servicing or when pumps have mechanical issues. As a result there is capacity to pump water in excess of the design capacity if necessary.

If groundwater pumping exceeds the maximum acceptable inflow into the mine for a prolonged period, the Nunavut Water Board is notified and the analyses and assessment described in the Aquatic Effects Monitoring Plan (AEMP) are carried out.

## 2.4 Lake Water Levels

The level of lakes located directly above underground mines may be affected by mining.

### 2.4.1 Management Action

Adaptive management strategies are implemented based on the MIMPs to limit the effects from mining to groundwater in taliks.

Lake water levels are monitored as outlined in the AEMP.

# 3 Inflow Control Measures

Potential inflow assessment and inflow control measures are put in place to anticipate and help limit the inflows from fractures, faults, or drill holes (referred to as “features” in the following discussion). These measures aim to:

- Protect worker health and safety;
- Prevent negative impacts due to mine inflow; and
- Provide improved working conditions for operations.

## 3.1 Risk Assessment

Risk assessments are used to guide development plans, with control measures worked into the mine schedule. Before planning a new development heading or any type of excavation, an assessment is made using the available information. Appropriate mitigation measures can be applied, if possible, before mining occurs (pre-grouting) or during mining activities (grouting being the main item in terms of adaptive management). Modifications to the mine design or the schedule can also be made when it is suspected that existing grouting capabilities won’t allow for proper control of suspected water inflows.

The data sources used as part of the risk assessment are updated regularly. Mining allows Agnico to continuously refine the 3D geology models of the mines and assess the probability of intercepting a significant water bearing structure.

The Diamond Drillhole Database (DDH) provides information about location, measured water inflow and status of grouting. The holes are displayed on all the development layouts issued by the Engineering department.

Hydrogeological studies are carried out as necessary to provide additional insight on the flow, flow direction, pressure regimen and to help identify recharge or drainage patterns.  Water quality is also considered in these studies.  Hope Bay documents the geological model and pertinent hydrogeological information in a Ground Control Management Document.

## 3.2 Inflow Control Measures

Inflow control measures such as grouting aim at plugging or significantly reducing the water flowing from a feature. As defined in the MIMP, they are meant to provide a response to a specific indicator.

These measures include:

- Probe drilling: In conformity with the Mine Health and Safety Act and Regulations, holes can be drilled prior to development when approaching an area with high water inflow potential. This precautionary measure will help inform further actions to mitigate the risk posed by sudden and incontrollable inflow. Potential actions being redesign of the excavation, change of location, pre-grouting or any combination of the three.
- Pre-grouting: Will be done based on probe holes results for larger areas like stopes or major infrastructures. Pre-grouting is also done on a smaller scale during lateral development when expecting significant inflow or mining in the vicinity of a known water bearing structure.
- Grouting: Grouting can be done post-excavation to control water inflow or to complement pre-grouting. Note that all water-making DDH are plugged (Margo plug) and then grouted.
- Isolation of the area: If deemed necessary, the appropriate strategy may be to isolate a specific area. In accordance with the Mine Health and Safety Act and Regulations, a suitable isolation barrier will be designed and constructed under the direction and guidance of a qualified engineer, with approval of the Mines Inspector.

# 4 Mine Inflow Management and Monitoring Program

The Mine Inflow Management Programs (MIMP) are decision-based frameworks specific to each mine aimed at preventing negative impacts from underground inflows; they complement the site Water Management Plans (Agnico 2022a). The MIMPs of the Doris, Madrid, and Boston mines are presented respectively in Module A, B and C.

## 4.1 Specific Indicators

Specific Indicators are used to assess performance of the system and trigger management actions. They are defined as:

**Total Mine Inflow**

- Daily flow measured at the main sump flow metering point.

**Point Source Inflow**

- Estimate of flow from a specific geological feature (structure/joint set) or drill hole; and
- Estimate of flow from a limited, specific mine area (i.e. heading or stope).

## 4.2 Specific Performance Thresholds

Specific Performance Thresholds (SPTs) are inflow rate-based decision points, triggering an escalating level of actions to manage the total mine discharge volumes and/or localised inflows. To ensure SPTs are appropriate, the inflows are measured such that the behaviour of the inflow system can be assessed as mining progresses and the SPTs are re-evaluated as part of the review process.

## 4.3 Specific Responses

Given that the mine inflow is expected to come from defined geological features or open drill holes in taliks, rather than dispersed inflow through the general rock mass, "Point Source" inflow monitoring is an important part of the continuing underground inflow characterisation as it relates to the understanding of the hydrogeological system and interaction with the mine development. Consequently, the SPTs and responses are set to assess the effectiveness of control measures and outline a review process for on-going management.

# 5 Monitoring and Evaluation

## 5.1 Inflow Quantification Monitoring

Monitoring underground flows aids in providing a feedback loop for evaluation of the effectiveness of the control measures and the accuracy of the predictive zone mapping. The accuracy and detail of the monitoring is a key component in the Plan review and evaluation process, so is included in the daily reporting structure of the underground management team (i.e. part of the Mine Supervisor daily report).

Underground flow monitoring includes pre- and post-grout flow measurements and flow feature description.

### 5.1.1 Pre-Grout Flow Measurement

Pre-grout flow measurement is needed to both aid in characterizing the feature and to support verifying the effectiveness of the grouting program. When possible, inflow from specific features or stopes is measured by monitoring pumping rates at the nearest collection sump. If inflow rates exceed pumping rates, this is noted as a rise in sump level, and another pump is mobilised to increase pumping capacity. These observations are documented by the Mine Supervisor and the Engineering department in the daily mine reports. If the inflow is unable to be estimated by sump level or pumping flow rate, a visual assessment will be made by the Engineering department and recorded in the Water Survey Database (Water Tracker).

### 5.1.2 Post-Grout Flow Measurement

Post-grout flow measurement is the primary means of verifying the effectiveness of the grouting program. Measurement techniques are the same as for pre-grouting.

The results and observations of the post-grouting measurements are considered as part of the review phases in the MIMP and the review of inflow control procedures.

### 5.1.3 Flow Feature Description

Detailed geological and geotechnical mapping is carried out using predetermined codes for specific rock types and conditions. To make the mapping of inflow features accessible for the review and evaluation process, a descriptive code system is incorporated into the site mapping codes. These coded features are added to the site geological/geotechnical mapping database for review and visualisation using standard reporting and modelling tools for the project.

## 5.2 Mine Inflow Quality Monitoring

During periods of mine water discharge, either directly to Roberts Bay, or to the TIA, mine water is sampled as follows:

- Weekly at the mine water discharge point (TL-12) for chloride, total dissolved solids (TDS), and nitrate;
- Monthly at the mine water discharge point (TL-12) , for total ammonia-N, nitrate-N, nitrite-N, pH, EC, ICPMS metals, alkalinity, acidity, sulphate, total suspended solids (TSS), major ions and total and weak acid dissociable (WAD) CN; and
- Twice annually from backfilled stopes, for total ammonia-N, nitrate-N, nitrite-N, pH, EC, ICPMS metals, alkalinity, acidity, sulphate, and total and WAD CN.

The Environmental Superintendent is responsible for conducting and documenting inflow water quality sampling. A record of this sampling and results of this analysis will be maintained on site.

## 5.3 Annual Geotechnical Inspection

A geotechnical inspection of the underground workings will be conducted by a qualified Geotechnical Engineer between July and September each year. The inspection will consider the groundwater conditions underground and groundwater inflow in the underground mine workings.

# 6 Adaptive Management

The review process outlined in the MIMP allows for performance (ingress control) to be assessed relative to the expanding knowledge of the site hydrogeological system. The following adaptive changes to inflow control measures could include:

- Review of discretionary vs. mandatory pre-grouting planning;

- Confirmation that pre-grouting plans are adequate for anticipating and preventing inflow;
- Modifications to pre-grouting plans or procedures to provide better inflow control;
- Changes to grouting techniques and materials;
- Modifying and/or adjusting the mine plan to avoid areas of concern; and
- Isolation of mining sections to avoid areas of concern.

# 7 Documentation and Reporting

Documenting inflows, adhering to inflow control measures, and consistent recording of grouting operations allow for an accurate assessment of the effectiveness of the ingress prediction and controls. Records pertaining to inflows and grouting are maintained and reviewed as part of the Plan review and evaluation process.

## 7.1 Inflow Inspections and Documentations

The underground operational crews are responsible for regular inspections of safely accessible non-working areas and providing daily reports of active work areas. Non-working areas are inspected monthly, or as necessary, if combined flows from those areas are observed to increase at main collection sumps.

Where new inflow or a change in inflow higher than 250 $m^3$/day is encountered, a description of the feature and related inflow characteristics are documented as part of the Mine Supervisor's daily report. This report includes:

- Description of features encountered;
- Inflow rates;
- Location; and
- Immediate mitigation actions taken, if applicable.

Active areas are inspected daily by Mine department employees and Supervisors. Observations are documented on the Work cars (employees) and the Daily report (Supervisors). The Engineering department performs monthly water inflow surveys that covers both active and non-working areas.

## 7.2 Grouting Logs

Grouting operations are documented to record the specific work done to stop/reduce inflows and to provide data for the Plan evaluation process. To capture the required data, the following details are logged during grouting events:

- Grout zone, location in mine plan, date, time, shift, crew members, and pre-grouting flow from numbered holes;
- Observations (i.e., geology, features, inflow) from the probe drilling completed in the zone;

- Materials used (type and volume); and
- Injection data such as packer position, pressures at start and end of each hole, flow rate development, and especially any cross-hole grout flow observed to come out of other holes or fractures as this gives an indication of fracture connectivity.

# 8 Contingencies

In circumstances of ensuring safety of workers and facilities, short term pumping of greater volumes with standby pumps might be required. If groundwater pumping rate and duration are greater than criteria specified in the MIMPs, the Nunavut Water Board is notified, and the analyses and assessment described in the AEMP are carried out and reported quarterly. Pumping will be directed to the TIA as opposed to directly to Roberts Bay. The TIA has sufficient holding capacity for storing one year of mine inflow at the maximum predicted rate for the Doris mine (1,095,750 $m^3$/year) or about one year and a half at the maximum predicted rate for the Madrid mines (632,000 $m^3$/year). The holding capacity of the TIA will be confirmed with the TIA Engineer of Record prior to pumping of groundwater to the TIA.

If excess inflow to the mine occurs and Agnico is unable to reduce total inflow to below the SPT-3 level within a reasonable period, the mines will have emergency storage capacity to store excess inflow if required. Underground sumps or lower parts of the mines can be use temporarily to manage and store groundwater, assuming it does not pose a safety risk.

# 9 References

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HOPE BAY PROJECT GROUNDWATER MANAGEMENT PLAN

HOPE BAY, NUNAVUT

# Module A: Doris Mine Inflow Management Plan (MIMP)

# Conformity Table

| Licence | Part | Item | Topic | Report Section |
|---|---|---|---|---|
| 2AM-DOH1335 | E | 4 | The Licensee shall implement the Plan entitled Hope Bay Project Groundwater Management Plan as approved by the Board. The Plan shall be reviewed annually in order to capture any revisions or updates necessary to adapt to changing circumstances regarding groundwater inflows and discharge rates. | 1.4 |

# A1 Doris MIMP

Table A.1 presents the Mine Inflow Management Program for the Doris mine. SPT-3 is set to be lower than the predicted maximum mine inflow of 3,000 $m^3$/d or 1,095,750 $m^3$/year. The maximum inflow rate was estimated based on the hydrogeological model developed for the Doris Mine in 2015 (SRK, 2015a). The modelling considered the site hydrogeological testing, mine design (3D geometry and void volumes), and sequencing (when tunnels and stopes are developed and then backfilled).

Discharge from the mine is at a rate of 3,000 $m^3$/day directly to Roberts Bay via the RBDS Pumphouse, or if required via the TIA. This discharge can be intermittent and occur any time of the year as the mine sumps fill naturally.

Table A.1: Doris Mine Inflow Management Program (MIMP)

| Specific Indicators | Specific Performance Thresholds | Specific Responses |
|---|---|---|
| **Mine inflows measured as:**<br><br>**Total Mine Inflow**<br>• Daily flow measured at the main portal flow metering point<br>**Point Source Inflow**<br>• Estimate of flow from specific geological feature (structure/joint set) or area<br>• Estimate of flow from a limited, specific mine area (i.e. heading or stope) | **SPT-1**<br>• Total mine pumping rate exceeds 1,000 $m^3$/day<br><br>• Point source inflow exceeds 250 $m^3$/day (~1.25 Lps) for > 3 days | **Notification**<br>• Agnico Management<br>**Review**<br>• Identify inflow point sources/areas and correlate to mine plan and MIMP<br>• Review of pre-grouting work carried out (QA/QC of work to date)<br>• Review inflow management records for development in affected areas<br>• Review inflow records versus geological model and mine layout to assess correlation<br>• Review lake level monitoring data<br>• Review records of mine pumping rates and discharge chemistry<br>**Evaluation**<br>• Review of UG inflow monitoring data to be undertaken by qualified professional and appropriate recommendations to be developed<br>• Review must consider the risk narrative (i.e. impact on Doris Lake water level and site discharge water quality objectives)<br>• Determine if lake level fluctuations exceed natural variability<br>**Action**<br>• Point source flow feature/area to be assessed by Agnico geological staff and compared to current geological model with objective to improve ability to predict significant inflow areas and correlation to pre-grouting planning<br>• Review of inflow control plan to see if techniques, coverage, materials, etc. should be modified or enhanced<br>• Supplemental grouting of source to reduce inflow |
| | **SPT-2**<br>• Total mine pumping rate exceeds 2,000 $m^3$/day<br><br>• Point source inflow exceeds 500 $m^3$/day (~3 Lps) for > 3 days | **Notification**<br>• As in SPT-1<br>**Review**<br>• As in SPT-1<br>• Review of geological model versus underground mapping and any new drilling data available<br>• Review probe drilling procedures and control measures in MIMP<br>**Evaluation**<br>• Review of underground inflow monitoring data to be undertaken by qualified professional, and appropriate recommendations to be developed<br>• Review must consider the effectiveness of predictive and control measures to date<br>**Action**<br>• As in SPT-1<br>• Update MIMP to integrate recommendations from review of prediction and control measures |
| | **SPT-3**<br>• Total mine pumping rate exceeds 2,500 $m^3$/day<br><br>• Point source inflow exceeds 800 $m^3$/day (~6 Lps) for > 3 days | **Notification**<br>• As in SPT-2<br>**Review**<br>• As in SPT-2<br>**Evaluation**<br>• Detailed review of all inflow events/sources to be undertaken by qualified professional, in addition to a 3rd party grouting specialist to provide peer review on control program<br>• Review of underground water management plan to deal with unexpected inflows that may exceed total mine discharge rate of 3,000 $m^3$/day<br>**Action**<br>• As in SPT-2<br>• Provide update to MIMP based on outcome of Peer Review<br>• assess potential impacts on Site Water Management Plan<br>• assess potential change in risk narrative<br>• Determine if mitigation measures required to maintain Doris Lake levels<br>• If groundwater pumping exceeds 3,000 $m^3$/day for a prolonged period, specifically 270,000 $m^3$/quarter, the Nunavut Water Board will be notified and the analyses and assessment described in the Aquatic Effects Monitoring Plan (AEMP) will be carried out and reported quarterly |

Note: Notification to the Mines Inspector is conducted as per the NWT Mine Health and Safety Act and Regulations Part XVI Reportable Incidents and Dangerous Occurrences Section 16.01 and 16.02. Notification to the Mines Inspector of a "dangerous occurrence" involving an inrush of water will include an oral report within 24 hours of the dangerous occurrence and a written report within 72 hours.

HOPE BAY PROJECT GROUNDWATER MANAGEMENT PLAN

HOPE BAY, NUNAVUT

# Module B: Madrid Mine Inflow Management Plan (MIMP)

# Conformity Table

| Licence | Part | Item | Topic | Report Section |
|---|---|---|---|---|
| 2AM-DOH1335 | E | 4 | The Licensee shall implement the Plan entitled Hope Bay Project Groundwater Management Plan as approved by the Board. The Plan shall be reviewed annually in order to capture any revisions or updates necessary to adapt to changing circumstances regarding groundwater inflows and discharge rates. | 1.4 |
| 2BB-MAE1727 | D | 4 | The Licensee shall submit to the Board for approval in writing, sixty (60) days prior to the commencement of underground workings at Madrid South, a Groundwater Management Plan. | Not applicable at this time. |

# B1 Madrid MIMP

Table B.1 presents the Mine Inflow Management Program for the Madrid North and Madrid South mines combined. SPT-3 is set to be lower than the predicted maximum mine inflow of 1,730 $m^3$/d or 631,882 $m^3$/year. The maximum inflow rate was estimated based on the hydrogeological model developed for the Madrid North and Madrid South Mine (SRK, 2017a). The modelling took into account the site hydrogeological testing, the mine design based on prefeasibility conditions and the mine production plan (TMAC 2017d).

The combined discharge from the Madrid North mine and Madrid South mine is to be at a rate of 3,000 $m^3$/day to Roberts Bay via the RBDS Pumphouse, or if required via the TIA. This discharge can be intermittent and occur any time of the year as the mine sumps fill naturally.

Table B.1: Madrid Mine Inflow Management Program (MIMP)

| Specific Indicators | Specific Performance Thresholds | Specific Responses |
|---|---|---|
| **Mine inflows measured as:**<br><br>**Total Mine Inflow**<br>• Daily flow measured at the main portal flow metering point<br>**Point Source Inflow**<br>• Estimate of flow from specific geological feature (structure/joint set) or area<br>• Estimate of flow from a limited, specific mine area (i.e. heading or stope) | **SPT-1**<br>• Total mine pumping rate exceeds 600 $m^3$/day<br><br>• Point source inflow exceeds 250 $m^3$/day (~1.25 Lps) for > 3 days | **Notification**<br>• Agnico Management<br>**Review**<br>• Identify inflow point sources/areas and correlate to mine plan and MIMP<br>• Review of pre-grouting work carried out (QA/QC of work to date)<br>• Review inflow management records for development in affected areas<br>• Review inflow records versus geological model and mine layout to assess correlation<br>• Review lake level monitoring data<br>• Review records of mine pumping rates and discharge chemistry<br>**Evaluation**<br>• Review of UG inflow monitoring data to be undertaken by qualified professional and appropriate recommendations to be developed<br>• Review must consider the risk narrative (i.e. impact on Patch and Wolverine Lake water level and site discharge water quality objectives)<br>• Determine if lake level fluctuations exceed natural variability<br>**Action**<br>• Point source flow feature/area to be assessed by Agnico geological staff and compared to current geological model with objective to improve ability to predict significant inflow areas and correlation to pre-grouting planning<br>• Review of inflow control plan to see if techniques, coverage, materials, etc. should be modified or enhanced<br>• Supplemental grouting of source to reduce inflow |
| | **SPT-2**<br>• Total mine pumping rate exceeds 1,200 $m^3$/day<br><br>• Point source inflow exceeds 500 $m^3$/day (~3 Lps) for > 3 days | **Notification**<br>• As in SPT-1<br>**Review**<br>• As in SPT-1<br>• Review of geological model versus underground mapping and any new drilling data available<br>• Review probe drilling procedures and control measures in MIMP<br>**Evaluation**<br>• Review of underground inflow monitoring data to be undertaken by qualified professional, and appropriate recommendations to be developed<br>• Review must consider the effectiveness of predictive and control measures to date<br>**Action**<br>• As in SPT-1<br>• Update MIMP to integrate recommendations from review of prediction and control measures |
| | **SPT-3**<br>• Total mine pumping rate exceeds 1,500 $m^3$/day<br><br>• Point source inflow exceeds 800 $m^3$/day (~6 Lps) for > 3 days | **Notification**<br>• As in SPT-2<br>**Review**<br>• As in SPT-2<br>**Evaluation**<br>• Detailed review of all inflow events/sources to be undertaken by qualified professional, in addition to a 3rd party grouting specialist to provide peer review on control program<br>• Review of underground water management plan to deal with unexpected inflows that may exceed total mine discharge rate of 1,730 $m^3$/day<br>**Action**<br>• As in SPT-2<br>• Provide update to MIMP based on outcome of Peer Review<br>– assess potential impacts on Site Water Management Plan<br>– assess potential change in risk narrative<br>• Determine if mitigation measures required to maintain Patch and/or Wolverine Lake levels<br>• If groundwater pumping exceeds 1,730 $m^3$/day for a prolonged period, specifically 158,000 $m^3$/quarter, the Nunavut Water Board will be notified and the analyses and assessment described in the Aquatic Effects Monitoring Plan (AEMP) will be carried out and reported quarterly |

Note: Notification to the Mines Inspector is conducted as per the NWT Mine Health and Safety Act and Regulations Part XVI Reportable Incidents and Dangerous Occurrences Section 16.01 and 16.02. Notification to the Mines Inspector of a "dangerous occurrence" involving an inrush of water will include an oral report within 24 hours of the dangerous occurrence and a written report within 72 hours.

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HOPE BAY PROJECT GROUNDWATER MANAGEMENT PLAN

HOPE BAY, NUNAVUT

# Module C: Boston Mine Inflow Management Plan (MIMP)

# Conformity Table

| Licence | Part | Item | Topic | Report Section |
|---|---|---|---|---|
| 2AM- BOS1835 | D | 13 | The Licensee shall, for all plans submitted under this Licence, implement the plan as approved by the Board in writing. Any changes to the plans deemed significant shall be considered as an amendment to the plan(s) or as a modification and must be submitted to the Board for approval in writing. The Board has approved under this Water Licence 2AM-BOS1835, the following plans for implementation under the relevant sections in the Licence: | This Plan |
| | | e. | *Hope Bay Project Groundwater Management Plan (March 2022)* | |

# C1 Boston MIMP

Table  C.1 presents the Mine Inflow Management Program for the Boston mine. The Madrid-Boston mine plan assumes mining in Boston will be limited to resources encapsulated in permafrost (TMAC 2017d). The spatial distribution of permafrost is based on the analyses of isotherms measured from thermistors at 08SBD381A, 08SBD382, and 10WBW004 (SRK 2017a).

Table C.1: Boston Mine Inflow Management Program (MIMP)

| Specific Indicators | Specific Performance Thresholds | Specific Responses |
|---|---|---|
| **Mine inflows measured as:**<br><br>**Point Source Inflow**<br>• Estimate of flow from probe drillhole or specific geological feature (structure/joint set) in new development.<br>• Estimate of flow from a limited, specific mine area (i.e. heading or stope) | **SPT-1**<br>• Point source inflow greater than 30 $m^3$/day (~0.3 Lps) for > 3 days | **Notification**<br>• Agnico Management<br>**Review**<br>• Identify inflow point sources/areas and correlate to mine plan and MIMP<br>• Review underground thermal measurements (QA/QC of monitoring to date)<br>• Review drilling records in affected areas<br>• Review permafrost model, geological model and mine layout to assess correlation with observed inflow<br>**Evaluation**<br>• Review of UG inflow and thermal monitoring data to be undertaken by qualified professional and appropriate recommendations to be developed<br>• Review must consider the risk narrative (i.e. impact on site water management objectives)<br>**Action**<br>• Point source flow feature/area to be assessed by Agnico to confirm inflow is generated from talik or subpermafrost<br>• Modification to mine plan to keep Boston development in permafrost if inflow is confirmed to come from talik or subpermafrost<br>• Inflow control (i.e., supplemental grouting of source inflow or installation of a borehole plugin device) or exclusion measures (i.e. isolation of the area concerned) |
| | **SPT-2**<br>• Point source inflow greater than 60 $m^3$/day (~0.6 Lps) for > 3 days | **Notification**<br>• As in SPT-1<br>**Review**<br>• As in SPT-1<br>• Review of geological model versus underground mapping and any new drilling data available<br>• Review probe drilling procedures and control measures in MIMP<br>**Evaluation**<br>• Review of underground inflow monitoring data to be undertaken by qualified professional, and appropriate recommendations to be developed<br>• Review must consider the effectiveness of predictive and control measures to date<br>• Action<br>• As in SPT-1<br>• Update MIMP to integrate recommendations from review of prediction and control measures |
| | **SPT-3**<br>• Point source inflow greater than 360 m3/day (~4.2 Lps) is observed in a new development | **Notification**<br>• As in SPT-2<br>**Review**<br>• As in SPT-2<br>**Evaluation**<br>• Detailed review of all inflow events/sources to be undertaken by qualified professional, in addition to a 3rd party grouting specialist to provide peer review on control program<br>• Review of water management plan to deal with unexpected inflows.<br>**Action**<br>• As in SPT-2<br>• Provide update to MIMP based on outcome of Peer Review<br>– assess potential impacts on Site Water Management Plan<br>– assess potential change in risk narrative<br>• Pump excess groundwater to surface to contact water ponds or directly to water truck for transport to Doris RBDS Pumphouse. Dispose of via RBDS Pumphouse to Roberts Bay.<br>• If groundwater pumping exceeds 360 m3/day for a period of 30 days, the Nunavut Water Board will be notified and mining of the area concerned will stop. |

Note: Notification to the Mines Inspector is conducted as per the NWT Mine Health and Safety Act and Regulations Part XVI Reportable Incidents and Dangerous Occurrences Section 16.01 and 16.02. Notification to the Mines Inspector of a “dangerous occurrence” involving an inrush of water will include an oral report within 24 hours of the dangerous occurrence and a written report within 72 hours.